

INTEGRATED SAFETY, HEALTH, AND ENVIRONMENT PLANNING AND
IMPLEMENTATION OF
ENVIRONMENTAL RESTORATION PROJECTS AT ROCKY MOUNTAIN ARSENAL

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ABSTRACT

The Rocky Mountain Arsenal (RMA) is a former chemical weapons production and demilitarization facility. The U.S. Army also blended hydrazine fuels for the US Air Force at RMA and leased facilities for the production of commercial pesticides. RMA is on the Environmental Protection Agency's (EPA) National Priorities List (NPL) and is undergoing environmental restoration. Site Characterization, remedial investigations, and a feasibility study will provide the framework for an integrated clean approach to be undertaken by the Army. The RMA Safety, Health, and Environment Office (SHE) is responsible to ensure the health and safety of employees, workers, and the public and to protect the environment during RMA remediation projects. The SHE Office teams with the project engineer, laboratory personnel, public affairs office, and legal staff from project inception through implementation and project completion. This proactive approach eliminates the need to react to issues that may not have been identified early in the planning process. The SHE Office reviews and approves project work plans and is the nucleus for coordinating the work activities of over 600 government and contractor employees at RMA. Review of project plans and oversight of projects ensures personnel are dressed in adequate levels of protection and proper monitoring is being conducted. Project review and oversight also ensures the wastes generated are properly labelled, stored, and disposed of in approved landfills. Examples of unique contamination problems associated with the environmental restoration program will illustrate the success of the RMA teaming approach. The decision criteria for selecting levels of protection, coordinating worker activities, and ensuring disposal facilities are properly permitted and operated are also presented.

INTRODUCTION

The United States Army Rocky Mountain Arsenal (RMA) is located approximately 10 miles (17 kilometers) northeast of Denver, Colorado. The Army manufactured, assembled, stored, and demilitarized chemical agent and incendiary munitions beginning in 1942. Following the Second World War (WWII), the Army leased portions of the industrial complex to private industry. Commercial pesticides and other chemicals were produced at RMA until 1982.

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The Program Manager for Rocky Mountain Arsenal was established in 1985 to manage the Army's environmental restoration at the arsenal. The Safety, Health, and Environment (SHE) Office is a Special Staff reporting directly to the Program Manager and is responsible for recommending procedures and practices which will safeguard human health and protect the environment throughout the clean up of RMA. The SHE Office works very closely with other RMA Special Staff, which includes Legal and the Public Affairs Office.

The Special Staff's role is to provide technical guidance to the RMA Project Team through the entire environmental restoration process. SHE Office support includes interpretation of regulatory requirements, mentoring both government personnel and civilian contractors, and providing an interface or liaison between the project team and regulators.

The integrated project team has evolved and changed tremendously over the past five years. The Army has learned many valuable lessons about performing environmental clean up utilizing government project managers and civilian contractors. This paper will discuss the role of the multidisciplinary SHE Office in coordinating and providing oversight of complex environmental clean up projects at RMA.

COMPOSITION AND FUNCTION OF THE SHE OFFICE

The SHE Office staff includes personnel with backgrounds in Occupational Safety, Industrial Hygiene, and Environmental Engineering. The Office has recently acquired the additional missions of Security and Chemical Weapons Treaty Coordination.

The concept of combining safety, industrial hygiene, and environmental protection into one office is a relatively new approach in the Army and has received praise from private contractors and other governmental agencies who have adopted the approach. The single office concept with sole responsibility or focus of protecting human health and the environment streamlines the clean up process by eliminating competing offices, reduces the amount of time and effort spent on multiple reviews and approvals of project plans. A single safety, health, and environment office eliminates confusion among contractors and government project engineers concerning which office is responsible for oversight of a particular project.

The function of the SHE Office is to provide advice and guidance to the Program Manager regarding safety, health, and environmental policies, practices, and regulations relating to environmental clean up. The SHE Office accomplishes its functions by reviewing and approving project plans, mentoring staff and contractors, ensuring proper safety, health, and environmental guidance is incorporated into project plans and assisting the Legal Office in interpreting technical guidance, regulations, and procedures.

Coordination of weekly activities, resolving scheduling or work conflicts, conducting audits, and interfacing with regulators are also functions of the SHE Office. In addition, the Office is responsible for determining levels of worker protection, performing hazard calculations,

reviewing environmental permits, and overseeing emergency response activities.

**CENTRAL SHE OFFICE CONCEPT:
A VALUE ADDED DIFFERENCE**

A central responsible SHE office reduces confusion for many of RMA's new contractors and subcontractors. On any given day, RMA can have over forty different projects and 600 personnel working on clean up efforts requiring health and safety support from the SHE staff.

Contrasting RMA's safety and environmental approach to the older style of safety and environmental management, highlights the Program Manager's commitment to protecting human health and the environment in a cost effective manner. Previous safety management systems relied heavily on inspection and reaction to changes. RMA's SHE office practices proactive project or customer assistance, thereby being an integral part of the solution.

As a member of the integrated project team, the SHE Office have determined the following precepts are keys to a successful project:

- a. Get involved early. Once a project (eg. an Interim Response Action) has been identified, SHE office personnel will meet with the project engineer and contractor and discuss the scope of the project, technologies involved, and time frame. Knowledge gained from these early meetings will assist in reviewing future project documents.
- b. Review and Approve Work Plans, Health and Safety Plans, and Waste Management Plans. Information gained from early meetings will assist in the detailed review. It is essential to have a basic understanding of project technologies or activities when reviewing the hazard assessments for each project phase. Key documents are the Work Plan which includes a description of activities and the Hazard Analysis contained in the Health and Safety Plan outlining the hazards associated with each phase of the project. The Waste Management Plan details how wastes will be managed throughout the project and disposal options for accumulated wastes.
- c. Mentor project engineers and contractors. Mentoring project personnel in basic safety, health, and environmental issues will reduce time spent reviewing and correcting plans, performing inspections and auditing projects, and can provide feedback from the field personnel on more complex safety and health issues.
- d. Share and disseminate information to project engineers and safety and health personnel. Forty environmental clean up projects can be ongoing simultaneously at RMA. A weekly coordination meeting has been established to provide personnel with information concerning scheduled activities. In addition, regular meetings of contractors performing similar tasks such as tank removal or asbestos abatement provides the opportunity to share lessons learned and update various projects. These meetings promote openness and sharing of common problems and solutions.

e . Helpful Audits. RMA contractors are tasked to perform the remediation project in a safe, healthful, and cost effective manner. The techniques used to audit the project can influence both safety and costs. Always invite the project engineer to participate in audits because only he or she can effect a change to contractor procedures unless a life threatening situation occurs during the audit. Strive to make on the spot corrections without work stoppages or the need for formal correspondence. Finally, listen to contractor comments and recommendations for project improvement.

INTEGRATED PROJECT OVERSIGHT PROJECT INITIATION

The **key** to integrated safety, health, and environmental oversight is identifying potential problem areas early in the project planning phase. Literature searches of past operations and operator knowledge can provide the team with information on potential hazards, contamination, and building construction which can be used in project planning. RMA has an extensive database on past operations, contamination plumes, and structures. Also, knowledge of applicable environmental or safety regulations and actions which may trigger trigger the need to apply for permits or approvals to perform certain projects are another reason to integrate the SHE Office early in the project. The SHE Office is the focal point for coordinating with higher Army headquarters and regulators for permit applications and may have additional insights on long lead time approval requirements from headquarters or regulators.

As mentioned before, the SHE staff must begin coordinating early with the project engineer and contractors to comprehend the scope of the project. It is critical for the SHE Office to have a basic understanding of the process or technology being recommended so they can adequately review the hazard analysis and recommend changes to enhance the analysis to give insight into potential project hazards.

A specific example of early SHE review involved the removal of asbestos from chemical process equipment piping. A review of the health and safety plan indicated the contractor would be working in Level C (half face respirator and no dermal protection). The process lines contained sodium hydroxide and were very corroded. The SHE Office recognized the need for higher respiratory and dermal protection and recommended full face respirators and chemically resistant clothing prior to project initiation and the SHE Office recommendations were implemented **by** the contractor.

PROJECT START UP: MANAGING CHANGE

Before field work occurs, the contractor will have received approvals from the staff and regulators on the project plans including the Health and Safety Plan, Work Plan, and Waste Management Plan. The team consisting of SHE, Environmental Engineering Project Engineer, Facilities Maintenance, Fire Protection, and Laboratory Support personnel will conduct a Pre Start Up Safety Review which is modelled after OSHA's Process Chemical Safety Start Up Review (PSSR). The process includes a review of project documentation, training records, and an emergency response exercise. Field work will commence once the team is satisfied with the PSSR results.

The first RMA PSSR involved the demolition of the hydrazine blending facility which included removal of asbestos from process piping and equipment, dismantling and removal of hydrazine piping, tanks, equipment, and demolition of structures, and site restoration. The PSSR reviewed project documents, personnel training, and evaluated an emergency response prior to commencing field activities.

Utilizing Pre Safety Start Up Reviews are extremely important when a project has high political visibility or is very controversial. We used a full scale PSSR to evaluate the Submerged Quench Incinerator which was designed and built to incinerate over 10 million gallons of highly corrosive liquids. The PSSR identified several problem areas in personnel training, maintenance documentation, and emergency response that were corrected before start up. The use of the PSSR helped ensure a successful SQI start up and the SQI has not had a reportable or recordable accident in over two continuous years of operation.

The ability to manage project change and not simply react is another benefit of the integrated project team concept. Changes in field conditions, project scope, and hazards are more easily identified using the team approach and the time spent to research and coordinate solutions is greatly reduced. Openness between the contractor and government team members, coordinating schedules, mentoring members in hazard recognition, and sharing potential solutions will reduce the time and cost associated with changes in environmental remediation projects.

When project conditions change or unidentified hazards are encountered, the team, led by the SHE Office, will review the Hazard Analysis. Team members from both the contractor and government will have an opportunity to agree on changes to the Hazard Analysis. As mentioned previously, the Hazard Analysis located in the Health and Safety Plan, will determine levels of personal protection, monitoring and sampling requirements, and ultimately, project costs associated with health and safety.

SAFETY, HEALTH, AND ENVIRONMENT REGULATIONS

Army clean up activities at RMA are governed by federal, state, local, and Army regulations. The Army is mandated to follow applicable federal environmental and safety requirements. Many of the regulations can overlap or conflict with each other and the role of the project team is to evaluate which law would apply to a certain clean up activity and gain concurrence from outside regulators.

The Legal Office takes the lead in mentoring project staff on the applicability of pertinent statutes but the SHE Office has the lead for Army unique safety requirements. The Army has very different requirements for personal protective equipment, monitoring, storage, and disposal of chemical warfare related equipment than those outlined by the Occupational Safety and Health Administration (OSHA) for hazardous waste operations.

Environmental clean up safety requirements can be found in several statutes but most hazardous waste remediations are covered in OSHA's Hazardous Waste Operations and Emergency Response (HAZWOPER) regulation found in the Code of Federal Regulations (29 CFR 1910.120). The HAZWOPER Standard identifies required planning, documentation, training, monitoring, medical surveillance, equipment, and emergency response which must be available to conduct hazardous waste operations. HAZWOPER applies to Comprehensive Environmental Response, Compensation, and Liability (CERCLA) or National Priority List (NPL) sites like RMA but similar activities are covered under the Resource Conservation and Recovery Act (RCRA) for treatment, storage, and disposal of hazardous wastes. The Standard is the basis for conducting site investigations, content of work plans, health and safety plans, site specific training, medical evaluations, and contingencies for emergency response.

The Army also has unique safety regulations for work involving the handling, storage, or disposal of chemical warfare agents and associated equipment and materials. Often, there are conflicts between the Army and other regulations which must be resolved by the SHE Office in order for the project to continue.

One such example of conflict resolution involved the disposal of chemical warfare agents and associated equipment. Determination of hazardous and non hazardous wastes is outlined in RCRA and based on either waste characteristics or listing of specific processes or chemicals while the Army bases suitability for disposal on equipment usage, location, and monitoring results. The Army method of waste determination is more stringent in most cases forcing RMA to use more costly disposal options. The SHE Office ensures that all chemical agent related wastes are properly disposed of in accordance with the more stringent Army requirements.

WORKER PROTECTION

Worker health and safety is the responsibility of every individual working on a hazardous waste site and is one of the two tenets of the SHE Office mission. As mentioned above, hazardous waste worker safety and health guidance comes from many sources including OSHA's HAZWOPER Standard, Construction Safety Standard (29CFR 1926), Army safety regulations, Occupational Safety and Health Guidance Manual for Hazardous Site Activities (commonly known as the Four Agency Handbook), and national safety and health organizations.

Worker Protection is a bottom up approach at RMA and is fully supported by management. Starting with the individual worker the integrated project team helps empower individuals to recognize and respond to job site hazards thereby eliminating the potential for most hazards to develop into serious problems.

PLANS

The two foundations of managing hazardous waste activities are found in the Work Plan and the Site Specific Health and Safety Plan (HASP). When the SHE Office receives project documents to review, we will match each work phase with the Hazard Analysis found in the HASP and correlate anticipated hazards mentioned in the Analysis with the controls identified to mitigate or reduce the hazard to an acceptable level. The SHE Office will resolve differences between their review and the contractor's proposal with the other team members.

A Site Specific Health and Safety Plan is required to conduct any hazardous waste operations. Much time, effort, and money is devoted to developing these plans for each project at RMA. The HAZWOPER Standard requires all HASPs to contain specific information on site history, location, past activities, and required site support. Since RMA is a fixed site with a well documented history of activities and contaminants and operational support is well established, the SHE Office has developed a RMA Health and Safety Plan which will cover all remediation activities. The use of a single site wide HASP greatly reduces the time and cost of preparing HASPs for each individual project. The contractor will only prepare a project specific addendum to the site wide HASP which describe the project activities and unique hazards, site controls, and emergency response activities relating to the project.

As mentioned before, the team should pay close attention to the Hazard Analysis and ensure it identifies all the potential hazards associated with an activity. One method of identifying project hazards is to establish and maintain a database of hazards associated with a particular project, i.e. hazards involved in building and operating a groundwater treatment system. The hazards should be identified by each phase of work and appropriate controls should be included. These activities and hazard controls can be shared with and reviewed by the contractor early in the planning phase. These lists are continually refined when new hazards are identified or site conditions differ from the base model. Preparation and use of these lists greatly reduce the time required to prepare, review, and

approve project hazard analyses.

CONTROLS

Controls for managing projects at RMA involve more than industrial hygiene precepts of engineering and administrative controls found in literature to control access to or isolate hazards. Controls used at RMA also include coordinating and scheduling work activities that may create hazardous conditions for workers at adjacent projects, clearly marking site boundaries, and controlling access to work sites.

The SHE Office conducts weekly scheduling meetings where information concerning project locations, types of activities, points of contact, levels of protection, road closures, or other special information is disseminated to all RMA and contractor personnel. Project information is recorded on a map and provided to personnel and is updated daily with changes provided by the responsible project engineer or contractor.

An example of a potential schedule conflict involved a contractor cutting, draining, and decontaminating process chemical lines while another contractor was removing asbestos from steam lines nearby. The asbestos removal contractor was not in an appropriate level of dermal or respiratory protection to adequately protect their workers from the chemical hazards presented by the adjacent contractor. The SHE Office recognized this potential problem and recommended the asbestos contractor shift his removal to after duty hours or upgrade their worker's level of protection. Activities coordination involving all team members have eliminated many instances where different projects had overlapping work zones, incompatible types of work being performed, or had project access roads closed during their projects.

Another method of site control is the clear demarkation of site boundaries using colored engineer tape or fences for long duration projects. The HASP requires the use of work zones to ensure activities are conducted in proper levels of protection at a project site. Clearly marking the boundaries of the project site will lessen the confusion between contractors and forces visitors to properly enter the project location.

ENGINEERING AND ADMINISTRATIVE CONTROLS

The selection and use of engineering and administrative controls by the project team can lead to a large cost savings from increased productivity for workers performing tasks that normally required higher levels of personnel protection. Examples include operating a backhoe with an overpressurized cabin compared to the operator wearing a self contained breathing apparatus (SCBA) or using supplied air respirator and performing support tasks in a lower level of protection outside the Exclusion Zone (EZ).

Beyond the monetary savings associated with the use of engineering and administrative

controls are those intangible benefits of increased worker protection and the lower risk of heat related illnesses associated with wearing personal protective equipment.

The collective experience of the team can recommend possible solutions or remedies to performing hazardous tasks which will lower costs associated with the task or provide a method of isolating the worker from the hazard.

Examples of engineering controls which have been recommended and used by the RMA project team includes the use of pressurized cabins for excavations, encapsulating and filtering contaminants at the point of release, filter hoods which attach to chemical containers to remove vapors while sampling and decontaminating the container. These engineering controls allowed the workers to perform their jobs in a lower level of personal protection while reducing the possibility of heat exposure injuries and increasing productivity.

Administrative controls integrated by the SHE Office includes performing tasks such as asbestos abatement of occupied buildings at night, allowing normal workers to return to their offices in the day, scheduling the flow of activities to support the overall cleanup, i.e. performing asbestos abatement prior to equipment removal, use of site boundaries already mentioned, and coordinating work activities in restricted portions of the arsenal. Nearly one half of the arsenal has been designated a Bald Eagle Management Area (BEMA) and is closed to clean up activities from October to April each year.

The project team has been able to coordinate certain clean up activities such as quarterly groundwater monitoring and sampling in the BEMA with the US Fish and Wildlife Service. Coordination involves a survey of the Bald Eagle roost area prior to entry and working during specific hours of the day.

MONITORING AND SAMPLING

The SHE Office reviews and approves industrial hygiene and safety related personal sampling and area monitoring plans as a part of the HASP. Sampling and monitoring at hazardous waste sites are usually more complex and variable than sampling for known contaminants at an industrial complex. Problems can arise because the chemical properties of the contaminant may not be well documented for certain media, such as soils or groundwater, and interactions between several contaminants may not be well understood.

The project team works very closely with the RMA Environmental Laboratory to provide support in determining types of sampling and analysis which will be required to support the remediation project.

The SHE Office and the laboratory provide technical assistance to project teams concerning Army chemical agent monitoring. Monitoring support with a Real Time Analytical Platform (RTAP), containing a Hewlett Packard 5890 Gas Chromatograph capable of sampling and analyzing three warfare agents within 12 minutes. The RTAP can process and analyze air samples taken by Dragger-like sampling tubes for area or personal sampling. Use of real time monitors capable of detecting

agents below the Airborne Exposure Levels (AEL) allows workers to perform army related remediation tasks in lower levels of protection.

An example of sharing sampling and monitoring information among project teams involved a contractor removing steam condensation lines and unexpectedly finding high levels of mercury in the lines. The contractor isolated the source of mercury and recommended procedures for sampling and removing mercury which would limit the sampling and monitoring effort necessary for other contractors working with similar steam lines. This approach was adopted by other contractors at RMA removing similar steam lines and saved RMA thousands of dollars in sampling and monitoring costs.

EMERGENCY RESPONSE

The focus of emergency response centers around the SHE Office and the integration of all the necessary functions required to respond to an accident or incident. RMA maintains an emergency response capability that blends together requirements from the National Contingency Plan (NCP) and the Army Chemical Accident/Incident Program. This unique plan allows RMA to respond to any accident, incident, or natural occurrence on the facility and gives the Program Manager the latitude to shape or mold the response elements to meet a wide array of emergency conditions.

The SHE Office coordinates and manages activities at both the accident site and the Emergency Operations Center (EOC) by use of team members from the responsible project and relaying key information back to the SHE representative in the EOC. RMA has four Installation On Scene Coordinators (IOSC) which have the responsibility to manage the incident and make appropriate notifications and requests for support to higher headquarters and regulators.

Through training exercises, RMA has learned many lessons on establishing and identifying critical elements of emergency response to hazardous waste activities. The arsenal has an extremely limited emergency response capability and must rely on the contractor performing remediation work to respond to limit or contain the release. The Army maintains mutual aid agreements with local fire departments and hospitals who would assist in emergency response activities concerning RMA.

The most important aspect of emergency response is assigning the task of containing and limiting release to the contractor performing the project. The level of response must be clearly stated in the contract and the expected number of personnel who would be available for support. In addition, the contract should require the contractor to have an emergency response contractor on call with a specified response time.

RMA requires all remediation contractors to provide information on their estimated worst case release or accident and identify the resources necessary to contain and isolate a spill or release. RMA has also identified an additional response force located within the RMA Hazardous Waste Storage.

For larger cleanup tasks or those projects with a risk of releasing large quantities of liquids to the environment, RMA requires the contractor to identify an offsite responder and give the approximate time to respond. All these contingencies should be identified in the contract and HASP.

The use of mutual aid agreements between nearby fire brigades or departments should be in place and exercised frequently. During the demolition of the hydrazine blending facility, a leak was discovered in a valve on the hydrazine decon water tank after normal duty hours. Adequate response personnel were not available from the RMA Fire Department or the contractor and mutual aid support from a nearby fire department was requested to assist in stopping the leak and containing the decon water.

Knowledge of unique hazards and conditions must be communicated to all emergency response personnel and exercises should be run prior to the start of new remediation projects that have the potential for releasing extremely hazardous materials or may be sensitive to the local community. For example, potential army chemical agent exposures cannot be taken to civilian hospitals but must be transported to Fitzsimons Army Medical Center, which is ten minutes from RMA. Both the emergency responders and the medical staff need prior notification that they may be transporting and treating a potentially chemically contaminated casualty. Exercises conducted with local hospitals and regulators will verify phone contacts, procedures, and ensure personnel lists are up to date and accurate.

CONCLUSIONS AND RECOMMENDATIONS: PROACTIVE TEAMS MANAGE CHANGE TOGETHER

Safety, Health, and Environment integration with environmental remediation project management at RMA has shown to be very successful. Project integration, sharing ideas and lessons learned with RMA contractors and project staff have increased worker safety awareness, decreased project costs associated with project safety planning and documentation, lowered personal protective equipment (PPE) and monitoring costs, and increased worker production. The RMA Program Manager has shown the benefits of including SHE support early in project development will decrease the time spent reviewing documentation, inspecting work practices, and resolving conflicts arising from changing conditions.